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Role of Annual Grasses and Shrubs in Nutrient Cycling of Great Basin Plant Communities

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ABSTRACT

This first year of investigation was primarily a pilot study. The study site was established in early spring and parameter samples were obtained in June and September. *Artemisia* shrub understory habitat had a higher cheatgrass (*Bromus tectorum*) productivity and thus a higher total nitrogen content than the interspace habitat. However, the cheatgrass nitrogen content per unit weight was higher in the interspace than the understory. A possible competititve advantage over herbaceous species is indicated. Soil nitrogen content decreased with depth and distance from the shrub canopy. Cheatgrass litter decomposition had by late summer released some nitrogen into the soil.

Study in 1972 will entail the construction of a nitrogen inventory at cheatgrass maturity and the subsequent examination of nitrogen mineralization from the cheatgrass litter. The effects of precipitation will be superimposed on the above study parameters.

INTRODUCTION

Emphasis in this first year of study was to develop methods of procedure which would provide the needed data sets for an understanding of the gross nutrient patterns of the cheatgrass (*Bromus tectorum*) - *Artemisia* shrub community in northern Utah. Sampling methods for productivity and nitrogen content analysis were refined while initial data provided information on the variability of parameters and the degree of future sampling intensity required.

The physical layout for the study was developed during the course of the spring and summer. The study site was fenced and six 10 x 10 meter study plots were delineated within the site. An irrigation system was developed for the three plots which are to undergo the simulated rainfall treatment.

The study site is located on a Lake Bonneville bench slope with a northwesterly aspect, 3 miles east of Tremonton in northern Utah.

METHODS

The treatment, applied to three of six 10 x 10 meter plots, consists of application of one inch of water per week during the spring growing season. Current year's growth is clipped from the confines of 15 x 15 cm quadrat, oven dried at 60°C and weighed. Cheatgrass samples are composited by habitat and plot. A micro-Kjeldahl steam distillation method (Bjerregaard, 1971) is used to obtain percent nitrogen of replicated samples. Cheatgrass biomass and nitrogen content are recorded under DSCODES A3UMD01 and MD02.

The sagebrush (*Artemisia tridentata*) community is stratified into understory and interspace habitats. Grid pattern is used to randomly select a shrub for sampling. Samples are taken from both understory and interspace habitats about each selected shrub. The quadrats are placed in randomly selected quadrants oriented from the center of each shrub.

Statistical work will utilize randomized complete block design for analysis of variance for treatment and habitat differences. Regression and correlation of soil nitrogen content with shrub nitrogen content, cheatgrass nitrogen content, litter nitrogen content and mulch nitrogen content, will be performed.

Soil samples are obtained from depths of 1, 3 and 15 cm and analyzed for percent nitrogen by Kjeldahl steam distillation.

FINDINGS

Due to the preliminary nature of the first year's study and the fact that no treatment effect was established, only a series of simple comparisons are available at this time. Tables 1 and 2 list the means of parameters sampled at cheatgrass maturity (June) and at the beginning of cheatgrass germination (September).

DISCUSSION

Cheatgrass productivity (June sampling period) is markedly greater in the understory habitat than in the interspace. The September sampling period shows a small drop in cheatgrass litter biomass in the understory habitat but none in the interspace. This apparent inconsistancy in the interspace is probably due to the different sampling methods used. In June, interspace biomass measurements were sampled at distances of 5 to 75 cm from the sagebrush canopy perimeter whereas in September all interspace samples were obtained at a distance of 20 cm from the canopy perimeter. Thus the September biomass figure (23.25 g) is biased towards a higher weight with regard to the June mean (24.89 g).

Cheatgrass total nitrogen content undergoes a decline during litter decay, thus giving evidence of nitrogen mineralization. The initial results indicate that cheatgrass nitrogen content is greater per unit weight in the interspace habitat during both sampling periods. Perhaps this is a measure of the competitive advantage that cheatgrass enjoys in "closing out" other species. Further study should determine whether this preliminary observation is statistically valid.

Table 1. Cheatgrass biomass and nitrogen content (mean values).

	June		September	
	Understory	Interspace	Understory	Interspace
Cheatgrass Biomass (g/m^2)	93.78	24.89	81.75	23.25
Cheatgrass Nitrogen Content (mgN/g)	11.40	12.90	7.20	8.25
(% N)	1.176	1.027	0.760	0.721

Table 2. Soil nitrogen content at 3 depths (mean values).

Soil Nitrogen				
1 cm depth (mg N/g)	----	----	2.04	1.65
(% N)	----	----	0.194	0.155
3 cm depth (mgN/g)	2.01	1.49	1.73	1.64
(% N)	0.194	0.142	0.163	0.154
15 cm depth (mg N/g)	1.27	1.25	1.40	1.34
(% N)	0.120	0.117	0.130	0.124

As expected, soil nitrogen content declines with depth and distance from the shrub canopy. Soil nitrogen at the 15 cm depth undergoes an increase from June to September in both habitats. This is most probably due to addition of nitrogen from the decaying cheatgrass litter above. This trend is also evident in the interspace habitat at the 3 cm depth but not in the understory. Future sampling should clarify this situation.

EXPECTATIONS

The study for 1972 will involve a thorough analysis of the nitrogen relations of the grassland-shrub ecosystem under study.

Treatment effect will be established during the spring and nitrogen content analysis will be conducted for both shrub understory and interspace habitats in relation to treatment effect. Also at this sampling period, a nitrogen inventory will be constructed from the previous year's cheatgrass growth (litter), community mulch component and soil type for the understory and interspace habitats of both treatments. Shrub productivity will be estimated in late summer prior to flowering.

The rate of nitrogen mineralization from the cheatgrass component will be evaluated by periodic sampling of the current cheatgrass litter during the following year.

A ceramic pressure plate will be used to obtain a moisture stress-water content curve for the study site soil type. Periodic soil moisture determinations will be obtained gravimetrically during the spring and related to moisture stress using the aforementioned curve.

Precipitation will be monitored throughout the cheatgrass growing season using two standard 8-inch diameter rain gauges.

LITERATURE CITED

Bjerregaard, Richard S. 1971. The nitrogen budget of two salt desert shrub communities of western Utah. Ph.D. Thesis, Utah State University, Logan, Utah.